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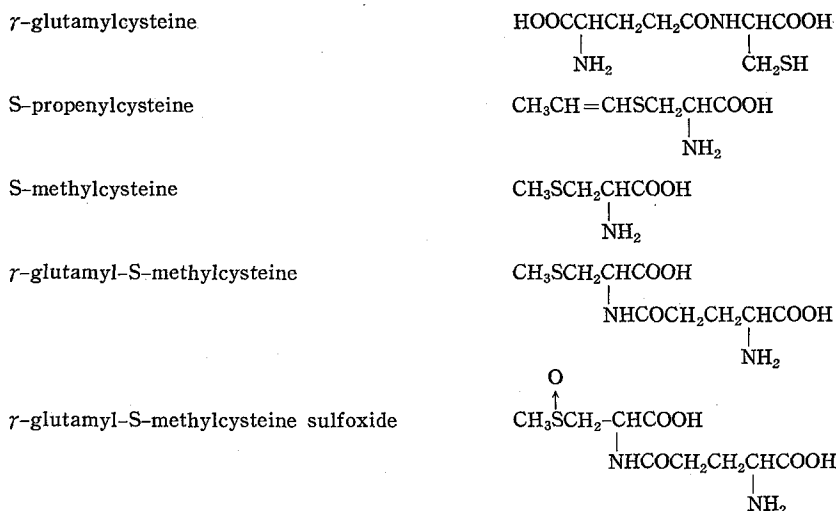
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We first attacked the problem of the sulfate metabolism during the hydroponic cultivation of garlic plant, and for this purpose the tracer technique using $^{35}\text{SO}_4^{2-}$ was employed. It was found that the roots of garlic possess the high synthetic ability of sulfur containing amino acids and the earliest major labeled amino acids were shown to be cysteine and methionine. After cultivation for 24 hours, the formation of S-allyl-L-cysteine sulfoxide and S-methyl-L-cysteine sulfoxide was observed. In addition to these characteristic sulfur containing amino acids, many unknown sulfur containing amino compounds were detected in radioautogram and by color reaction with ninhydrin and chloroplatinate reagents, and the chemical structures of these compounds were determined as follows:

New sulfur containing amino acids and peptides were isolated from bulb of garlic.

S-allylcysteine	$\begin{array}{c} \text{CH}_2=\text{CHCH}_2\text{SCH}_2\text{CHCOOH} \\ \\ \text{NH}_2 \end{array}$
S-propylcysteine	$\begin{array}{c} \text{CH}_3\text{CH}_2\text{CH}_2\text{SCH}_2\text{CHCOOH} \\ \\ \text{NH}_2 \end{array}$
S-(2-carboxypropyl)cysteine	$\begin{array}{c} \text{CH}_3\text{CHCH}_2\text{SCH}_2\text{CHCOOH} \\ \quad \\ \text{COOH} \quad \text{NH}_2 \end{array}$
cycloalliin (3-methyl-1,4-thiazane-5-carboxylic acid)	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}-\text{CH}_2 \\ \quad \\ \text{HN} \quad \text{S} \rightarrow \text{O} \\ \quad \\ \text{CH}-\text{CH}_2 \\ \\ \text{COOH} \end{array}$
γ -glutamyl-S-allylcysteine	$\begin{array}{c} \text{HOOCCHCH}_2\text{CH}_2\text{CONHCHCOOH} \\ \quad \\ \text{NH}_2 \quad \text{CH}_2\text{SCH}_2\text{CH}=\text{CH}_2 \end{array}$
S-(2-carboxypropyl)glutathione	$\begin{array}{c} \text{HOOCCHCH}_2\text{CH}_2\text{CONHCHCONHCH}_2\text{COOH} \\ \quad \quad \\ \text{NH}_2 \quad \text{CH}_2\text{SCH}_2\text{CHCOOH} \\ \\ \text{CH}_3 \end{array}$
homomethionine (L-5-methylthionorvaline)*	$\begin{array}{c} \text{CH}_3\text{SCH}_2\text{CH}_2\text{CH}_2\text{CHCOOH} \\ \\ \text{NH}_2 \end{array}$
γ -L-glutamyl-S-allylmercaptocysteine	$\begin{array}{c} \text{HOOCCHCH}_2\text{CH}_2\text{CONHCHCOOH} \\ \quad \\ \text{NH}_2 \quad \text{CH}_2\text{SCH}_2\text{CH}=\text{CH}_2 \end{array}$

* This amino acid was isolated from cabbage.



Sulfur containing amino acids which had been isolated from bulb of garlic: cysteine, cysteic acid, methionine, methionine sulfoxide, alliin(S-allylcysteine sulfoxide), S-methylcysteine sulfoxide

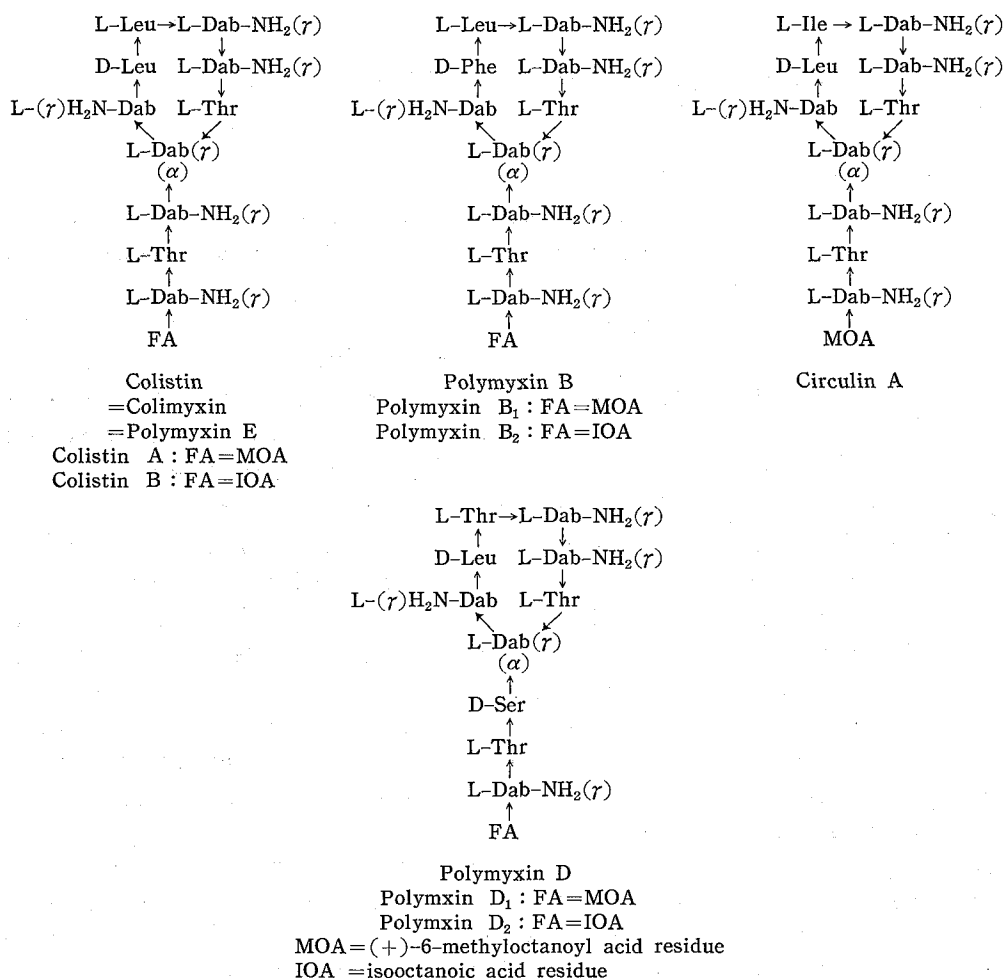
In parallel with the demonstration of the chemical structures of these sulfur containing amino compounds, the studies on the biosynthesis have been performed. (1) Incorporation of L-valine into S-(2-carboxypropyl) glutathione and S-(2-carboxypropyl)cysteine: It is known that valine is metabolized *via* methacryl coenzyme A in the animal. From this fact, it was considered that the origin of 2-carboxylpropyl group of S-(2-carboxypropyl)glutathione was assumed to be an intermediate metabolite of valine, such as methacrylic acid or the coenzyme A derivative. Therefore, the experiment has been designed to obtain a precise evidence for the origin of 2-carboxypropyl group of this peptide by using uniformly labeled-L-valine- ^{14}C . The ^{14}C -labeled valine was fed to excised root of garlic under sterile conditions and localization of radioactivity of the isolated amino compounds was examined. By these experiments, it was proved that uniformly labeled-L-valine- ^{14}C is incorporated into 2-carboxypropyl group of S-(2-carboxypropyl)glutathione and S-(2-carboxypropyl)cysteine in excised root of garlic. It was also found that leucine is formed from valine in a similar fashion as reported in various microorganisms.

(2) Biosynthesis of S-methyl-L-cysteine and S-methyl-L-cysteine sulfoxide from methionine: S-methyl-L-cystine and its sulfoxide are widespread occurred in plants. Arnold and Tompson have shown that S-methyl-L-cysteine sulfoxide is formed from biological oxidation of S-methyl-L-cysteine in crucifers. Although Wolf et al. have found that S-methyl-L-cysteine is enzymatically synthesized in an extract of yeast from methyl mercaptan and L-serine, the biogenes of S-methyl-L-cysteine in higher plant is obscure. It has been known that methyl mercaptan can be arisen in microorganisms and in the rat from methionine. We obtained an evidence that S-methyl-L-cysteine and its sulfoxide were formed from methionine in garlic plant.

The study of the other part was to elucidate the chemical structures of polymyxin

series antibiotics. The antibiotic substances designated as polymyxin have been isolated from the culture broth of *Bacillus polymyxa*, a spore-forming rod occurring in soil. The chemical structures of these antibiotics had been studied by many workers, but the structures proposed were not satisfactory to account for all the properties of the natural substances. We elucidated the chemical structures of colistin's A and B, circulin A, polymyxin's B₁ and B₂, and polymyxin's D₁ and D₂, and also confirmed that the structure of polymyxin E₁ was identical with that of colistin A while that of polymyxin E₂ was the same as that of colistin B.

Chemical structures elucidated in our laboratory are as follows:



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